





## SPECIFICATION

## Centrifuge tube sealing assembly

The present invention relates to a centrifuge-tube sealing assembly, and centrifuge tubes and sealing systems for use in such assemblies.

Samples are often centrifuged in plastics sample tubes. These have an open end for inserting sample into the tube and subsequently removing it. In some forms of centrifuge rotor it is necessary to close this open end, notably with rotors where the longitudinal axes of the sample tubes are generally parallel to the axis of rotation of the rotor, or vertical tube rotors as they will be denoted herein. The methods used to seal the tubes have often been cumbersome and require the use of several components. In order to overcome the problems met with the use of mechanical seals, it has been proposed to form the sample tubes with a narrow outlet, which is then heat sealed to provide a permanent closure to the sample tube. However this means that each tube can only be used once and must then be discarded.

The aim of this invention is to provide a simple form of sealing system in which the sample tube can be re-used.

According to the invention we provide a centrifuge tube sealing assembly which comprises in combination a centrifuge tube, a support member and a closure member, the tube having one end closed and one end open and being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, the support member being capable of receiving the tube and supporting the tube by means of the rib, the closure member being capable of closing the open end of the tube, and engaging the rib, the support and closure members having cooperating faces such that the rib is capable of being held between the closure member and the support member and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

The circumferential rib may be detachable from the centrifuge tube, for example it may be in the form of a deformable collar. However we prefer the centrifuge tube and the circumferential rib to be formed integrally from the same material, for example as a single moulded plastics lipped tube.

The circumferential rib may be located a short distance, for example 3 mm, from the open end of the centrifuge tube; however it is preferred that the circumferential rib is located at the rim of the open end of the centrifuge tube.

The circumferential rib may be made from plastically deformable material, or preferably elastically deformable material, for example a polymer such as a polyolefin, a polycarbonate or a fluorinated hydrocarbon polymer.

By deformable material, we mean material which is deformed under load at ambient temperature.

The upper face and the lower face of the rib may taper together away from the tube. However, we prefer the upper face and the lower face of the rib to be generally parallel to one another. We particularly prefer the rib to comprise an inner portion inclined away from the closed end of the tube, and an outer portion at right angles to the long axis of the tube.

The support member may be a component, capable of fitting in, and being supported by, the tube-carrying recess in a centrifuge rotor, for example an annulus, or the support member may be provided by the rim of the tube-carrying recess in a centrifuge rotor.

When the support member is an annulus, the closure member, support member and centrifuge tube form a sealed assembly which can be removed and handled separately from the rotor.

The closure member may form a snug fit with the open end portion of the centrifuge tube.

However we prefer the closure member to carry a tapered interior projection which is capable of engaging the rib and splaying the rib radially and axially against the support member.

According to the invention we also provide a centrifuge tube which comprises an elongate tube having one end closed and one end open, the tube being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, such that the rib, in association with a support member and a closure member, the support member being capable of receiving the tube and supporting the tube by means of the rib, the closure member being capable of closing the open end of the tube and engaging the rib, the support and closure members having cooperating faces, is capable of being held between the closure member and the support member, and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

According to the invention we further provide a support and sealing system, suitable for use with a centrifuge tube having one end closed and one end open and being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, which comprises a support member capable of receiving the tube and supporting the tube by means of the circumferential rib, a closure member capable of closing the open end of the tube and engaging the rib, the support and closure members having cooperating faces such that the rib is capable of being held between the closure member and the support member and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

An embodiment of the invention will now be described by way of example only, and with reference to the accompanying drawing which is a vertical cross-section of an assembly according to the invention.

Referring to the drawing, the assembly comprises a centrifuge tube 1 closed by a closure member 2 and an annular support member 3, the assembly being capable of fitting in, and being supported by, a tube carrying recess of a centrifuge rotor.

The centrifuge tube 1 is provided with a rounded closed end 5 and an open end 6. A circumferential rib 7 extends radially outwards from the rim of the open end of the tube 1, the rib comprising an upwardly angled portion 8 and a horizontal portion 9. The upper face 10 and the lower face 11 of the rib 7 are generally parallel to one another.

The lower part of the support 3 is provided with an inwardly extending peripheral shoulder 13, capable of supporting the rib 7. The upper face of the shoulder 13 corresponds with, and abuts the lower face 11 of the rib 7.

The inner side wall 14 of the support 3 and the outer side wall 15 of the closure member 2 have co-operating surfaces in the form of a screw thread arrangement.

The bottom face 16 of the closure member 2 is provided with a horizontal peripheral surface 17 and a tapered projection 18, the surface 17 and projection 18 corresponding with, and abutting the upper face 10 of the rib 7.

The tapered projection 18 is provided with a cylindrical extension 19, with an external diameter slightly smaller than the internal diameter of the tube 1.

The closure member 2 is provided with a central axial channel 20 which terminates with a conical opening 21 within the bottom end portion of the extension 19.

The upper end portion of the channel 20 is sealably closed by a grub screw 22 which bears on a washer 23. The closure member 2 is further provided with an integral nut portion 24 extending upwardly from the upper surface, peripheral to the upper opening of the channel 20, to assist in screwing the closure member 2 in and out of the support member 3.

Screw adjustment of the plug 2 into the support 3 holds the circumferential rib 7 between the closure member 2 and the shoulder 13 of the support 3, causing the rib 7 to undergo both radial and axial deformation, effecting a sealing engagement between the closure member 2 and the shoulder 13.

The sealing system of the invention can be applied to a wide range of centrifuge tubes and centrifuge rotors, but is of especial use with tubes of from 3 to 100 ml capacity in a vertical or near vertical ( $\pm 10^\circ$ ) tube rotor.

Where the support member 3 is in the form of the tube carrying recess of a centrifuge rotor, the invention provides a sealing system which requires only one component, the closure member 2, in addition to using a lipped tube 1 in place of the conventional non-lipped tubes.

#### Claims

1. A centrifuge tube sealing assembly which

65 comprises in combination a centrifuge tube, a support member and a closure member, the tube having one end closed and one end open and being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, the support member being capable of receiving the tube and supporting the tube by means of the rib, the closure member being capable of closing the open end of the tube, the support and closure members having cooperating faces such that the rib is capable of being held between the closure member and the support member and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

2. An assembly according to Claim 1, wherein the centrifuge tube and the rib are formed integrally from the same material.

85 3. An assembly according to either one of the preceding Claims, wherein the rib is located at the rim of the open end of the centrifuge tube.

4. An assembly according to any one of the preceding Claims, wherein the rib is made in an elastically deformable material.

90 5. An assembly according to any one of the preceding Claims, wherein the upper face and the lower face of the rib are generally parallel to one another.

95 6. An assembly according to Claim 5, wherein the rib comprises an inner portion inclined away from the closed end of the tube, and an outer portion at right angles to the long axis of the tube.

7. An assembly according to any one of the preceding Claims, wherein the support member is in the form of an annulus.

8. An assembly according to any one of Claims 1 to 6, wherein the support member is a tube-carrying recess in a centrifuge rotor.

105 9. An assembly according to any one of the preceding Claims, wherein the closure member carries a tapered interior projection which is capable of engaging the rib, and splaying the rib radially and axially against the support member.

110 10. A centrifuge tube which comprises an elongate tube having one end closed and one end open, the tube being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, such that the rib, in association with a support member and a closure member, the support member being capable of receiving the tube and supporting the tube by means of the rib, the closure member being capable of closing the open end of the tube and engaging the rib, the support and closure members having cooperating faces, is capable of being held between the closure member and the support member, and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

11. A centrifuge tube according to Claim 10,

wherein the external circumferential rib is located at the rim of the open end of the tube.

12. A centrifuge tube according to Claim 10 or 11, wherein the external circumferential rib is made in an elastically deformable material.

13. A centrifuge tube according to any one of Claims 10 to 12, wherein the external circumferential rib and the container are formed integrally from the same material.

14. A centrifuge tube according to any one of Claims 10 to 13, wherein the upper face and the lower face of the rib are generally parallel to one another.

15. A support and sealing system suitable for use in association with a centrifuge tube having one end closed and one end open and being provided with an external circumferential rib on the open end portion thereof, the rib being made from a deformable material, which comprises a support member capable of receiving the tube and supporting the tube by means of the circumferential rib, a closure member capable of closing the open end of the tube and engaging the rib, the support and closure members having cooperating faces such that the rib is capable of

being held between the closure member and the support member and can be caused to undergo both radial and axial deformation to effect a sealing engagement between the closure member and the support member.

16. A support and sealing system according to Claim 15, wherein the support member is in the form of an annulus.

17. A support and sealing system according to Claim 15, wherein the support member is a tube-carrying recess in a centrifuge rotor.

18. A support and sealing system according to any one of Claims 15 to 17, wherein the plug member carries a tapered interior projection which is capable of engaging the rib and splaying the rib inwardly and axially against the support member.

19. An assembly according to Claim 1 substantially as herein before described.

20. An assembly substantially as hereinbefore described with respect to and as shown in the accompanying drawing.

21. A centrifuge provided with an assembly according to any one of Claims 1 to 8, 19 or 20.